ZOOLOGIA 36: e36293
ISSN 1984-4689 (online)
zoologia.pensoft.net

RESEARCH ARTICLE

A new fossil species of the crabronid wasp genus *Tracheliodes* (Hymenoptera: Crabronidae) from Dominican amber

Gabriel A.R. Melo[1], **Brunno B. Rosa**[1]

[1]*Laboratório de Biologia Comparada de Hymenoptera, Departamento de Zoologia, Universidade Federal do Paraná. Caixa Postal 19020, 81530-980 Curitiba, Brazil.*
Corresponding author: Gabriel A.R. Melo (garmelo@ufpr.br)

http://zoobank.org/70D21FB8-3942-4D80-8AF7-1D6F2B1CAC3D

ABSTRACT. The first fossil species of the wasp genus *Tracheliodes* from Dominican amber is described. *Tracheliodes grimaldii* **sp. nov.** is based on a single female specimen exhibiting a somewhat generalized morphology compared to the extant fauna. While the new species resembles the Neotropical species in a few characters, it does not possess the many specialized features exhibited by this species group, especially those related to the female legs. This is the 4th genus and the 7th species of apoid wasps described from Dominican amber.

KEY WORDS. Apoidea, Crabronini, fossil, taxonomy.

INTRODUCTION

The amber from the Dominican Republic is an important fossiliferous deposit because of its abundance and availability, fine preservation, in addition to rare kinds of inclusions (Grimaldi and Engel 2005, Penney 2010). The detailed reconstruction of the ecosystem indicates a vanished tropical forest (Grimaldi 1995, 1996). The age has been estimated to be Early Miocene through early Middle Miocene, about 15 to 20 million years ago, according to available biostratigraphic and paleogeographic data (Iturralde-Vinent and MacPhee 1996).

More than 200 species of hymenopterans have been described from Dominican amber inclusions and only six of them are apoid wasps (Penney 2010). They all belong to Crabroninae (Crabronidae): three species of *Trypoxylon* Latreille, 1796, two of *Pison* Jurine, 1808 (both genera in Trypoxylini), and one of *Lindenius* Lepeletier, 1839 (Crabronini) (Pulawski 2019). The Crabronini comprises the largest tribe of Crabronidae with a world sum of 48 genera and 1,498 species (Pulawski 2019). *Tracheliodes* Morawitz, 1866 has currently 17 species, eight of them in the Palearctic region, three in the Nearctic, and six in the Neotropical region (Melo and Rosa 2015). Additionally, the genus has three fossil species, *T. mortuellus* Cockerell, 1906 from Florissant, Colorado (Miocene), and *T. succinalis* (Cockerell, 1909) and *T. tornquisti* (Cockerell, 1909) from Baltic amber (Pulawski 2019). In this paper we describe the first fossil species of *Tracheliodes* from Dominican amber.

MATERIAL AND METHODS

The studied material belongs to the Amber Fossil Collection, Division of Invertebrate Zoology, American Museum of Natural History (AMNH). Terminology for external morphology follows Bohart and Menke (1976) with a few modifications. The photographs were obtained with a LEICA DFC295 digital camera attached to the stereoscopic microscope LEICA M125, and finished in the software Zerene Stacker (1.04 version build).

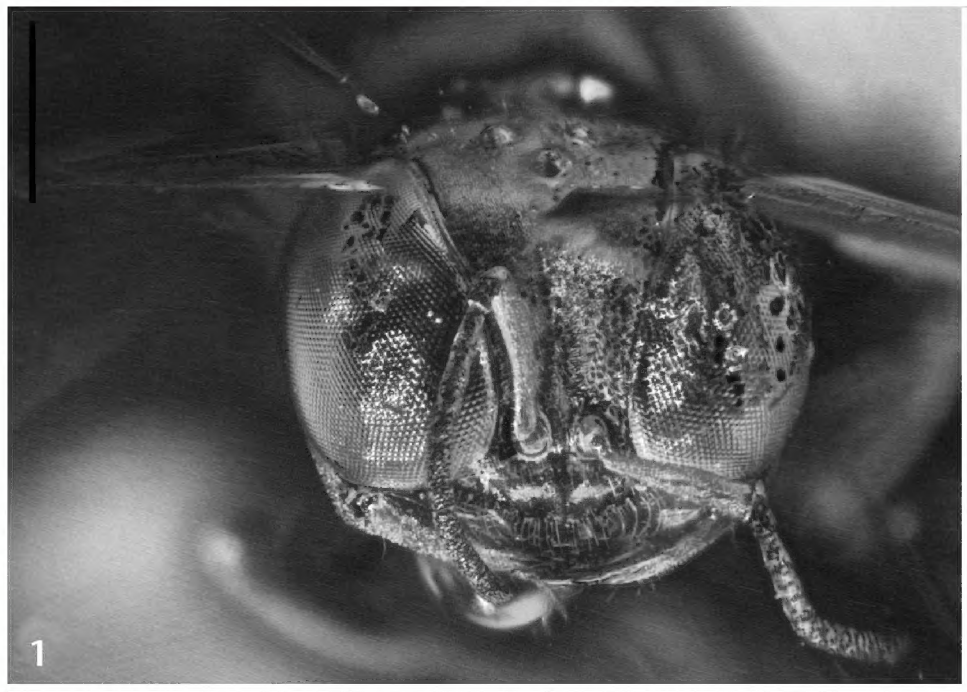
TAXONOMY

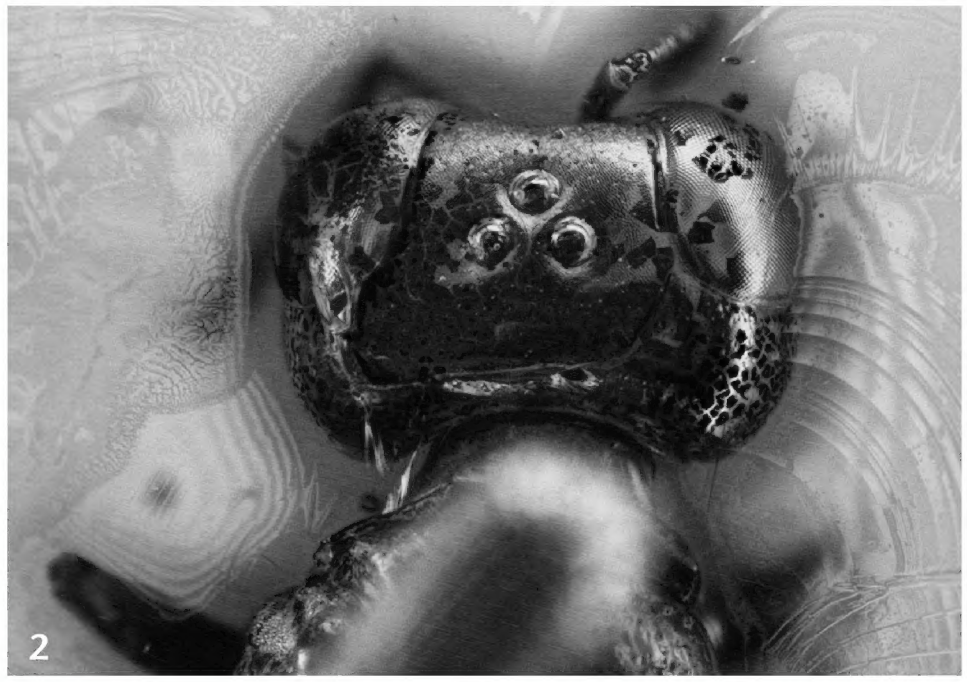
Hymenoptera Linnaeus
Apoidea Latreille
Crabronidae Latreille
Tracheliodes Morawitz

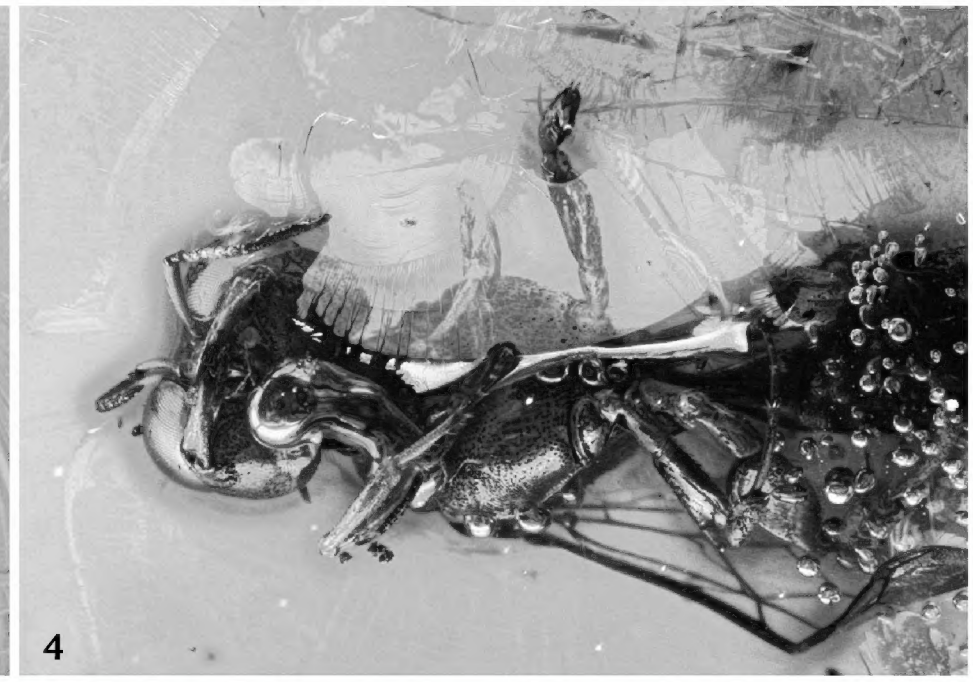
Tracheliodes grimaldii sp. nov.

http://zoobank.org/CB5DF3D6-3B55-4115-8AC4-693B70FA4F21
Figs 1–9

Diagnosis. *Tracheliodes grimaldii* sp. nov. can be set apart from the living taxa by the following combination of characters: (1) Thick setae along lower margin of clypeus relatively short, their length subequal to diameter of antennal socket; (2) Clypeal disc weakly convex, without medial protuberance; (3) Distance between antennal socket and eye orbit short, subequal to the distance between sockets; (4) Upper frons and vertex relatively



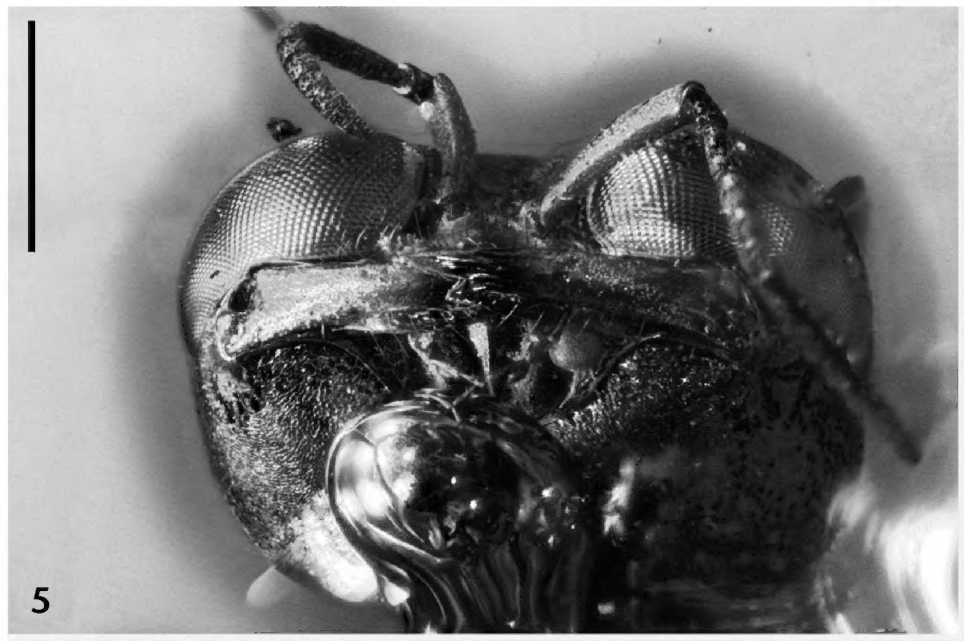


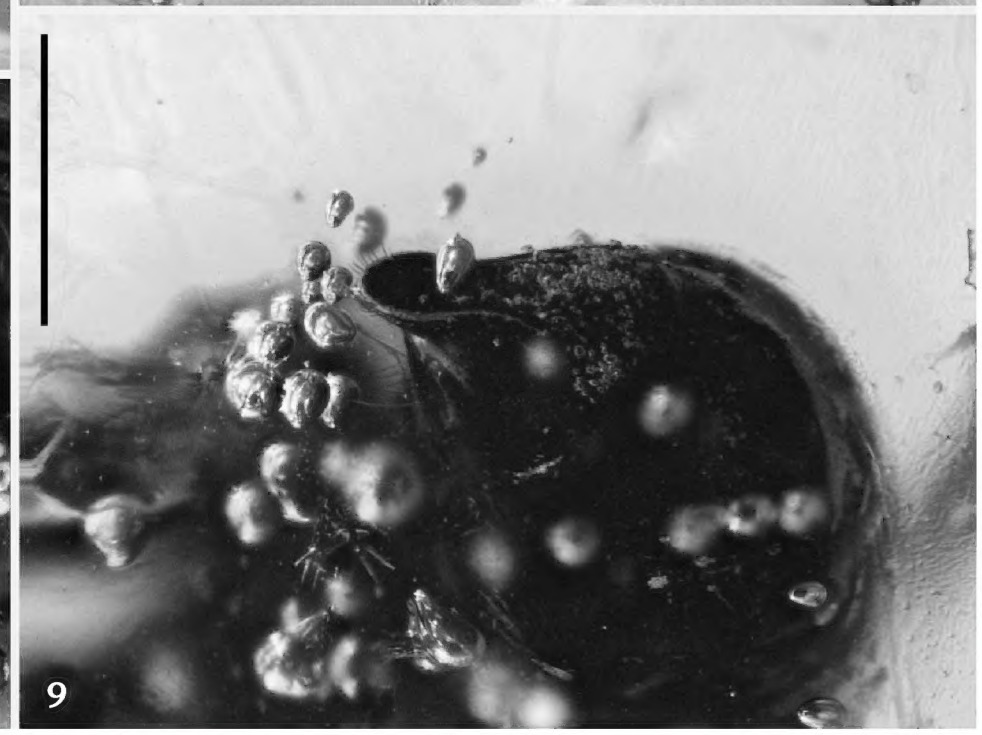


Figures 1–4. Holotype female of *Tracheliodes grimaldii* sp. nov. (1) Head, frontal view; (2) Head and anterior portion of mesosoma, dorsal view; (3) Habitus, lateral view; (4) Habitus, ventral view. Scale bars = 1mm (Figs. 1 and 2, and Figs. 3 and 4, respectively at same scale).

flat, without conspicuous undulations of the integument; (5) Fore femur fusiform, not expanded ventrally, its lower surface devoid of thick bristles; (6) Mid femur fusiform, not expanded dorsally; (7) Mid tibial spur unmodified and relatively short; (8) Hind femur strongly thickened in the basal third, its anterior surface mostly flat; (9) First metasomal segment petiolate, dorsal surface of petiole convex; (10) Pygidial plate tear-shaped, with relatively weak preapical narrowing.

Description. Female holotype. **Measurements** (in mm). Approximate body length, 6.5; maximum head width, 1.9. **Pilosity.** Head and mesosoma mostly glabrous with sparse, fine and very short appressed hairs. Lower margin of clypeus with preapical line of long setae, their length subequal to diameter of antennal socket, lateral ones longer, thicker and slightly curved inwards; clypeal disc with sparser and shorter setae on its upper half; lower margin of gena with short and dense pilosity; parocular area, along scapal basin, with a dense strip of short, decumbent hairs facing outwards; dorsal surface of scape with numerous decumbent micro-setae. Anterior half of lateral portion of mesepisternum, behind omaular carina, with conspicuously dense short pilosity. Foreleg: lower surface of femur devoid of thick bristles; basitarsus with a row of short and thick bristles along inner margin, its posterior margin with a row of five bristles, bristles almost as long as diameter of basitarsus. Midleg: femur with thick bristles on posterior surface, inner surface with erect bristles directed towards apex, those on ventral surface slightly longer; anterior surface of tibia, right above the spur, with a pair of conspicuous lanceolate bristles; apical third of tibia with short thick setae on outer surface, these similar to those on remainder of tibia (not forming spininiform bristles), except for an apical pair of thick spiniform bristles. Hindleg: trochanter with a conspicuous patch of short decumbent setae; femur with thick relatively long bristles on anterior surface, bristles erect and directed towards apex; tibia with sparse, very thick, short bristles on outer surface; basitarsus with row of thick and short bristles forming a comb along its inner margin. Metasoma without conspicuous pilosity, except for few short setae on ventral portion of S6 and on margin of T6 bordering pygidial plate. **Integumental surface.**





Figures 5–9. Holotype female of *Tracheliodes grimaldii* sp. nov. (5) Head, ventral view; (6) Head and anterior portion of mesosoma, lateral view; (7) Posterior portion of mesosoma and anterior portion of metasoma, lateral view; (8) Mid and hind right legs, lateroventral view; Fig. 9. Pygidial plate, dorsal view. Scale bars = 1mm (Figs. 6 and 7, at same scale).

Head and mesosoma finely microreticulated, dull. Pronotum with few parallel carinae in front of pronotal lobe. Posterior two-thirds of lateral surface of mesepisternum, metepisternum, and lateral portion of propodeum finely microstriated, striation more conspicuous on mesepisternum and metepisternum; omaular carina well developed and reaching mesepisternal sulcus ventrally, adjacent region behind carina with small foveae; mesepisternal sulcus weakly indicated and not foveolated. **Structure.** Head: cly-

peus transverse, its lateral portions very narrow, its lower margin with three broad teeth in the middle, lateral teeth aligned with antennal socket, disc weakly convex without projection; tentorial pit situated at the transition between inner and lower orbits, area around it weakly depressed; distance between antennal sockets subequal to the distance from socket to the inner orbit of compound eyes; scapal basin relatively shallow, only slightly depressed relative to lateral surface; distance between lower inner orbits approximately 0.7× width of eye in frontal view; gena in lateral view approximately 1.2× as wide as compound eye; upper frons and vertex relatively flat, without conspicuous undulations of the integument; ocello-orbital distance 1.6× the distance between posterior ocelli; distance between anterior and posterior ocelli about half the distance between the posterior ocelli; facial fovea linear, its length about 1.4 the distance between posterior ocelli. Foreleg: femur fusiform, not expanded ventrally. Midleg: femur fusiform, not expanded dorsally, its lower portion flat, apical portion of anterior surface weakly excavated ventrally; tibial spur short, less than one-third of basitarsal length; basitarsus cylindrical, oval to circular in section. Hindleg: trochanter basically circular in section; femur strongly thickened in the basal third, its maximum height approximately 2.5× apical height, anterior surface mostly flat; hind tibia clavate as in other species of the genus; basitarsus gently curved and approximately 1.35× as long as mid basitarsus; inner tibial spur about 1.8× as long as outer spur. Metasoma: 1st segment petiolate and gradually broadening posteriorly; width of petiole approximately one-fourth of apical width of T1, in lateral view; dorsal surface of petiole convex; pygidial plate tear-shaped, flat, with relatively weak preapical narrowing, its margins limited by a low carina.

Type material. Holotype female, in amber piece AMNH no. PB- 118, bearing the following labels: 'Amber: Dominican Republic,\Specific Locality unknown\(Oligomiocene). Purchased in\Santo Domingo by Paul F. Burke.\AMNH no. PB- 118\Identifications:/Sphecidae/Platypodidae' 'PB118'. The piece measures 12 x 10 x 6 mm, and possesses a dark reddish orange color. The amber forms a darker reddish halo around the wasp specimen. The wasp wings are folded downward, making it difficult to observe both the wings and the metasoma; also, there are numerous air bubbles around its metasoma. There is a small beetle (Platypodinae, Curculionidae) at ca. 2 mm above the holotype.

Etymology. The species is named after the curator of AMNH's amber collection, David A. Grimaldi, who has kindly made the material available for study.

DISCUSSION

Its worldwide distribution, with few and morphologically divergent species, and relatively ancient fossil record (Baltic amber) suggests that *Tracheliodes* represents a relictual lineage within the Crabronini. Indeed, in Bennett's (2010) phylogenetic study of the tribe, *Tracheliodes* came out in a relatively isolated position, at the base of his *Rhopalum* series. The genus differs from other crabronine genera by its elongate fore trochanter and a broad frons with the antennal sockets well separated from the inner orbits, which are only moderately convergent below (Bohart and Menke 1976). Also, Bennett (2010) lists as putative synapomorphies for *Tracheliodes* the loss of the silver setal patch of the clypeus, elongate F1, elongate fore trochanter, an anteromedially flat T1, lack of lateral articular line on T2, and additional features of the male terminalia. As far as it is known, all species prey on ants (references in Melo and Rosa 2015).

Considering the composition of the Dominican amber fauna (Penney 2010), one would expect that *T. grimaldii* sp. nov. should have a closer relationship to the species of the extant Neotropical fauna. This new species, however, has a somewhat generalized morphology and does not show a particular resemblance to any of the extant Neotropical species. The Neotropical species group is very characteristic and shares numerous unique conditions: (1) Lateral lobes of clypeus with very long setae; (2) Anterior tentorial pit situated in deep fovea; (3) Ventral surface of fore femur strongly expanded and with a row of specialized short bristles; (4) Dorsal surface of mid femur strongly expanded; (5) Bristles on apex of outer surface of mid tibia arranged in two parallel rows; (6) Metasomal petiole well defined, at least a long as one-third of the length of T1, with its dorsal surface completely flat. Also, except for *T. carnavalus* Leclercq, the mid and hind legs of the females are highly modified in this group (see Melo and Rosa 2015). All Neotropical species also have a median protuberance on the clypeal disc, with the exception of *T. amazonicus* Fernández & Amarante, 2004. Despite lacking these features, *T. grimaldii* sp. nov. could still turn out as sister-group of the lineage that gave rise to the Neotropical group. For example, its tear-shaped pygidial plate, with a preapical narrowing, and the broad hind femur are similar to the conditions exhibited by females of the Neotropical species. A more precise positioning of the new species must await future phylogenetic studies involving the worldwide fauna of *Tracheliodes*, something beyond the scope of the present contribution.

The new species described here represents the seventh known apoid wasp from Dominican amber. Its discovery reinforces the bias toward crabronine inclusions in this amber. *Tracheliodes* is known to nest predominantly in preexisting holes in wood (Zettel et al. 2004, Melo and Rosa 2015), a behavior that together with ant hunting make them more prone to be trapped in plant resins. Further exploration of Dominican amber accessions will certainly reveal new apoid wasps belonging to other groups besides Crabroninae. Indeed, we have examined a female specimen of *Spilomena* Shuckard, 1838 (Pemphredoninae) from the AMNH amber collection that remains undescribed.

ACKNOWLEDGEMENTS

This work started a long time ago when Caroline Chaboo brought a series of AMNH's Dominican amber specimens to the attention of the first author. We thank her and David Grimaldi

for the opportunity to study this material. We also would like to thank the reviewers Wojciech Pulawski and Germán Villamizar for suggestions that helped improve this article. Partial support has been provided by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) to BBR (grant 158310/2018-7) and to GARM (grant 309641/2016-0).

LITERATURE CITED

Bennett DJ (2010) Phylogenetics of Crabronini, with a consideration of the evolution of predatory and nesting behaviors (Insecta: Hymenoptera: Crabronidae). Ph.D. thesis, University of Kansas, Lawrence, 189 pp. https://kuscholarworks.ku.edu/handle/1808/7627

Bohart RR, Menke AS (1976) Sphecid wasps of the world: A generic revision. University of California Press, Berkeley, 695 pp.

Cockerell TDA (1909) Descriptions of Hymenoptera from Baltic amber. Schriften der Physikalisch-Ökonomischen Gesellschaft zu Königsberg 50: 1–20.

Grimaldi DA (1995) The age of Dominican amber. In: Anderson KB, Crelling JC (Eds) Amber, Resinite, and Fossil Resins. American Chemical Society, Washington DC, ACS Symposium Series, 203–217.

Grimaldi DA (1996) Amber: window to the past. Harry N. Abrahams, New York, 216 pp.

Grimaldi DA, Engel MS (2005) Evolution of the insects. Cambridge University Press, New York, 722 pp.

Iturralde-Vinent MA, MacPhee RDE (1996) Age and paleogeographical origin of Dominican amber. Science 273: 1850–1852.

Melo GAR, Rosa BB (2015) A new species of the ant-hunter genus *Tracheliodes* Morawitz (Hymenoptera: Crabronidae: Crabronini) from Brazil. Zootaxa 3941: 421–428. https://doi.org/10.11646/zootaxa.3941.3.8

Penney D (2010) Dominican Amber. In: Penney D (Ed.) Biodiversity of fossils in amber from the major world deposits. Siri Scientific Press, Manchester, 22–41.

Pulawski WJ (2019) Catalog of Sphecidae *sensu lato*. https://www.calacademy.org/scientists/projects/catalog-of-sphecidae

Zettel H, Ljubomirov T, Steiner FM, Schlick-Steiner BC, Grabenweger G, Wiesbauer H (2004) The European ant hunters *Tracheliodes curvitarsus* and *T. varus* (Hymenoptera: Crabronidae): taxonomy, species discrimination, distribution, and biology. Myrmecologische Nachrichten 6: 39–47.

Submitted: May 17, 2019
Accepted: August 28, 2019
Available online: November 1, 2019
Editorial responsibility: Gabriel L.F. Mejdalani

Author Contributions: GARM and BBR planned the work, wrote the manuscript and revised the final version.
Competing Interests: The authors have declared that no competing interests exist.
© 2019 Sociedade Brasileira de Zoologia. Published by Pensoft Publishers at https://zoologia.pensoft.net